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[Title in German of the object of the invention:]  
Infrarotstrahler mit langgestreckten Widerstandskörper als  
Strahlungsquelle

INFRARED RADIATOR, HAVING LONGITUDINALLY STRETCHED-OUT RESISTOR  
CORES IN THEIR CAPACITY AS SOURCE OF RADIATION

(57) An infrared radiator is provided with one or more longitudinally stretched-out resistor cores of carbon-fiber ribbon, which have on their relevant ends a medullization domain, upon which a U-shaped contact clamp [clip] is placed, and, if necessary, welded; the core resistors are located in a capillary chamber of a quartz-glass enclosure, which is evacuated or filled with inert gas; the power supply takes place by means of molybdenum sealing-fouls, which by means of contact pins are connected in an outward as well as in an inward direction to the contact clamps.

## Description

The invention pertains to an infrared radiator, having longitudinally stretched-out source of radiation, which is surrounded by a hermetically sealed quartz-glass enclosure, whereby the source of radiation is designed as ribbon-shaped core resistor [resistance body], and at least on two ends is electrically and mechanically connected to sealed current lead-ins [current feedthroughs], leading outwards.

From the German patent specification DE-P 39 38 437, there is known an infrared radiator, having longitudinally stretched-out, monolithic twin tubes, having inner web, which separates from one another two partial chambers, passing in the longitudinal direction, and provided with incandescent filament [thermionic single-coil filament], whereby the radiator contains sealed current lead-ins [current feedthroughs]. The radiator should be capable of being optionally heated along its entire length or along a partial length by means of outer connector pin assignments [pin configurations] while the radiator is used for the delivery of short-wave infrared radiation.

In doing so, the relatively expensive installation of an incandescent filament, which requires separate locking and stabilization elements along its entire length, turned out to be

a problem.

From the World Intellectual Property Organization application WO 92/05411, there is known a source of infrared radiation in the form of a carbon-fiber ribbon, stretched by means of stretching elements, through which carbon-fiber ribbon there flows electric current. Besides the radiation, which emerges frontally, perpendicularly to the direction of the surfaces, the radiation, which is directed rearward, is additionally reflected by means of a reflector system, which also emerges in frontal direction.

Due to the fact that the radiation emerges as being directed through an opening, a use of the infrared-radiation source as longitudinally stretched-out infrared radiator is not suitable in the practice.

Moreover, from the brochure "Mittelwellige Carbon-Strahler CRS: hohe Prozeßsicherheit und Effizienz" [Medium-wave Carbon Radiator CRS; High Process Safety and Efficiency] (Identification number: 3C 12.93/NT&D) of the Heraeus Noblelight G.m.b.H., there are known longitudinally stretched infrared radiators, having a carbon-fiber ribbon as source of radiation. In doing so one of the ends of the carbon-fiber ribbon is connected to a frontal contact by means of a helical spring, in order for an elongation compensation to be guaranteed when heating takes place. However, when the length of the ribbon is more than 1 meter, the complete elongation compensation is not immediately guaranteed.

The objective to specify infrared radiators, in particular longitudinally stretched infrared radiators, having a length of more than 1 meter, for the purpose of irradiation, which proliferates along planes [in a planar way], respectively along a line [linearly], while the axial stability is preserved, whereby flat heating elements, respectively radiator elements, are used, which, where applicable, provide an opportunity for a high modulation of the radiation intensity, forms the basis of the invention.

In accordance with the invention, the set objective is achieved by means of the characteristic features of claim 1,

The fact that a high load-bearing capacity of the carbon-fiber ribbon, respectively of the carbon ribbon, is possible, due to the gasproof sealing, turned out to be advantageous, whereby for the purpose of manufacturing, reference can be made to the already existing technology of gasproof sealed quartz lamps, respectively infrared radiators. Another advantage is to be seen in the circumstance that more carbon-fiber ribbons can be arranged parallelly to one another, in order for a large-area infrared-irradiation to be achieved.

Additional advantageous embodiments are specified in the subclaims.

The relatively rapid response of the infrared radiation, contingent upon the power supply, so that, e.g., a modulation of the delivered or dissipated infrared radiation is possible,

turned out to be of particular advantage in accordance with the invention.

The object of the invention is elucidated in greater detail as follows by means of Figs. 1a, 1b, 1c, 2a, 2b, 2c.

Fig. 1 diagrammatically shows a longitudinal section through a longitudinally stretched-out infrared radiator for the general [surface] irradiation, with a view upon the source of radiation.

Fig. 1b diagrammatically shows a cross-section along line AB of Fig. 1, having circular quartz-glass capillary tube, respectively quartz-glass slotted capillary tube;

Fig. 1c also shows a section along line AB of Fig. 1a, having a surface-squeezed quartz-glass capillary tube, resp. quartz-glass slotted capillary tube.

Fig. 2a diagrammatically shows a longitudinal section of an infrared radiator for surface irradiation, having two radiation sources, located next to one another in a quartz-glass capillary tube, having two hollow chambers, arranged parallelly to one another.

Fig. 2b diagrammatically shows a cross-section along line CD of Fig. 2a, having a capillary-tube cross-section in the form of eight [8], while Fig. 2c shows a flat capillary tube, having two radiation sources, located next to one another, as shown in section CD of Fig. 2a.

In accordance with Fig. 1a, the resistor core [resistance body] 1, designed as carbon-fiber ribbon, is arranged as

radiation source in a hollow chamber 2, diagrammatically represented by dotted lines, which hollow chamber 2 is surrounded by a quartz-glass slotted capillary tube, respectively a quartz-glass encasement 3. The electrical power output of the radiation source are defined by the cross-sectional area and length of the resistor core 1 while the resistor core 1 has medullization domains 6 and 7 on its ends 4, 5, respectively, which medullization domains by way of a U-shaped contact clip, mounted in a force-closed way\* [\*Translator's note: i.e. in a frictional or non-positive way), are connected to contact pins 10, 11 attached thereon. In addition to this, the contact clips 8, 9 can be welded to the medullization domain 6, 7. On their part, the contact pins 10, 11 are again rigidly connected in an electrical and mechanical way to the sealing films 12, 13 for the feedthrough as a result of resistance welding, which sealing films lead through the sealed domain of the quartz-glass encasement. The outer connection takes place by means of outer contact pins 14, 15, which are also connected as a result of resistance welding to the sealing films 12, 13 in an outward direction through the quartz encasement. The sealing of the sealing films together with the welding contacts of the contact pins is undertaken by means of a squeezing method, which is conventional in the quartz-lamp technology. The pin 11 is designed in the form of an array element, in order for an elongation compensation, respectively longitudinal compensation

to be guaranteed when the resistor core is heated up. Molybdenum is provided in its capacity as a particularly suitable material for the sealing films.

Fig. 1b shows a section along line AB of Fig. 1 whereby it can be discerned that the resistor core 1 is located inside the hollow chamber 2, which is formed by the surrounded quartz tube 3, respectively the glass encasement. In the case of such a slotted flat channel, the reaction velocity of the medium-wave infrared source of radiation turned out to be particularly advantageous, because it is not considerably impaired by the thermal inertia of the surrounded quartz material.

Fig. 1c is also a diagrammatic representation of a cross-section along line AB of Fig. 1a whereby, in that case, an oblate quartz capillary tube 3 is used, which - due to its small thickness - provides an opportunity for an irradiation, proliferating in a planar way [along planes], which is free of shear strain.

The hollow chamber of the quartz-glass capillary tube has a height in the range of 1 to 3 mm, and a width of 4 to 12 mm while the ratio of height to width constitutes approximately 1 : 4.

Fig. 2 diagrammatically shows a longitudinal section of two resistor cores [resistance bodies] 17, 18, arranged parallelly to one another, which are located in a hollow chamber 19, 20 of a quartz-glass slotted capillary tube 21, respectively, which hollow chamber is denoted by dotted lines, and by means of

medullization areas 22, 23, 24 and 25 are connected at their relevant ends by means of U-shaped contact clips 26, 27, 28, 29, mounted in a force-closed manner, which contact clips, on their part are again provided with contact pins 31, 32, 33, 34 while the contact pins 33, 34, which are arranged parallelly to one another, are designed as array elements, which - due to their spiral structure - subject the ribbon-shaped resistor cores [resistance bodies] to tensile stress, in order for a thermal expansion to be compensated over the course of the operation. The contact clips 26, 27, 28 and 29 can additionally be welded to the relevant medullization domain 22, 23, 24 and 25.

The contact pins 31, 32, 33 and 34 are rigidly connected in an electrical and mechanical way as a result of resistance welding whereby the sealing films - for the purposes of on outer contacting - are connected to the contact pins 41, 42, 43 and 44 as a result of resistance welding. The sealing films 36, 37, 38 and 39 are sealed in a gasproof manner together with the welding contacts of the contact pins by means of a squeezing method, which is usually employed in the engineering for the manufacturing of quartz lamps. Because each of the two resistor cores 17 and 18 has its own outer contacts, it is possible - according to the case of application - to form a parallel or series circuit of both core resistors by means of outer switching (circuit) means.

Fig. 2 b shows a cross-section trough the quartz double-tube



system in the form of an eight (8) along line CD of Fig. 2. Inside the quartz-glass double tube 21, there are the capillary slotted hollow chambers 19, 20, in which a resistor core [resistance body] 17, 18 is arranged, respectively. With the help of Fig. 2b, it can be discerned that both hollow chambers 19, 20 are completely separated from one another by means of a partition web 45.

Fig. 2c shows a variant of the cross-section along line CD in accordance with Fig. 2b, whereby the capillary quartz-glass double-tube system is flattened, in order for an opportunity to be provided for an improved transmission without optical focussing or bundling of the generated infrared radiation. In doing so, design and mode of operation essentially correspond to the embodiment form, diagrammatically represented in Fig. 2b, so that relevant reference numerals or symbols are also used.

Carbon ribbons, having a thickness of 0.15 mm and a width of 10 to 11 mm proved a success as materials for the resistor cores [resistance bodies] while nickel is in particular used as medullization material. The contact pins, connected with the medullization as a result of resistance welding, consist of molybdenum whereby the sealing films, connected thereto, also consist of molybdenum while the other contact pins also consist of molybdenum.

#### Patent Claims

1. Infrared radiator, having longitudinally stretched-out source of radiation, which is surrounded by a gasproof quartz-glass encasement, whereby the radiation source is designed as ribbon-like resistor core [resistance body], and at least on two ends is electrically and mechanically connected to hermetically sealed current lead-ins [feedthroughs], **characterized in that** the resistor cores [resistance bodies] (1, 17, 18) are arranged in a quartz-glass capillary tube (3, 21).

2. Infrared radiator, as claimed in claim 1, characterized in that a carbon-fiber ribbon is provided in its capacity as resistor core [resistance body] (1, 17, 18).

3. Infrared radiator, as claimed in claim 2, characterized in that the carbon-fiber ribbon has a thickness of 0.1 to 0.15 mm whereby its ratio of thickness to width is in the range from 1 : 10 to 1 : 70.

4. Infrared radiator, as claimed in one of the claims 1 thru 3, characterized in that the inner hollow chamber (2) of the quartz-glass capillary tube (3) has a height in the range from 1 to 3 mm, and a width in the range from 4 to 12 mm.

5. Infrared radiator, as claimed in claim 4, characterized in that the ratio of height to width constitutes approximately 1 : 4.

6. Infrared radiator, as claimed in one of the claims 1 thru 5, characterized in that at least two resistor cores (17, 18) are

arranged in own slit recesses (19, 20) of the quartz-glass encasement (3), respectively, which recesses are located in the same plane, whereby a partitioning quartz-glass web is arranged between both resistor cores.

7. Infrared radiator, as claimed in claims 1 thru 6, characterized in that for the purpose of power supply through the quartz-glass encasement there are provided at least two sealing films (12, 13, 36, 37, 38, 39), which are connected by means of a contact clip (8, 9, 26, 27, 28, 29), respectively, to a medullization area (6, 7, 22, 23, 24, 25) of the resistor core (1, 17, 18).

8. Infrared radiator, as claimed in claim 7, characterized in that medullization domain or area (6, 7, 22, 23, 24, 25) is nickel-plated.

9. Infrared radiator, as claimed in claim 7 or 8, characterized in that the contact clip (8, 9, 26, 27, 28, 29) is connected to the medullization domain (6, 7, 22, 23, 24, 25) by means of a force-closure [frictional connection or non-positive closure] and by means of an additional resistance welding.

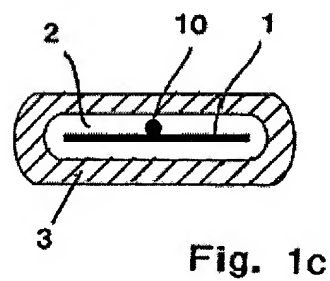
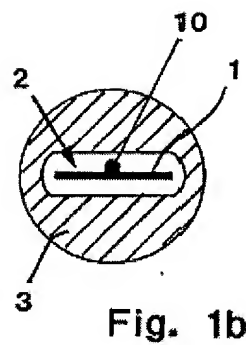
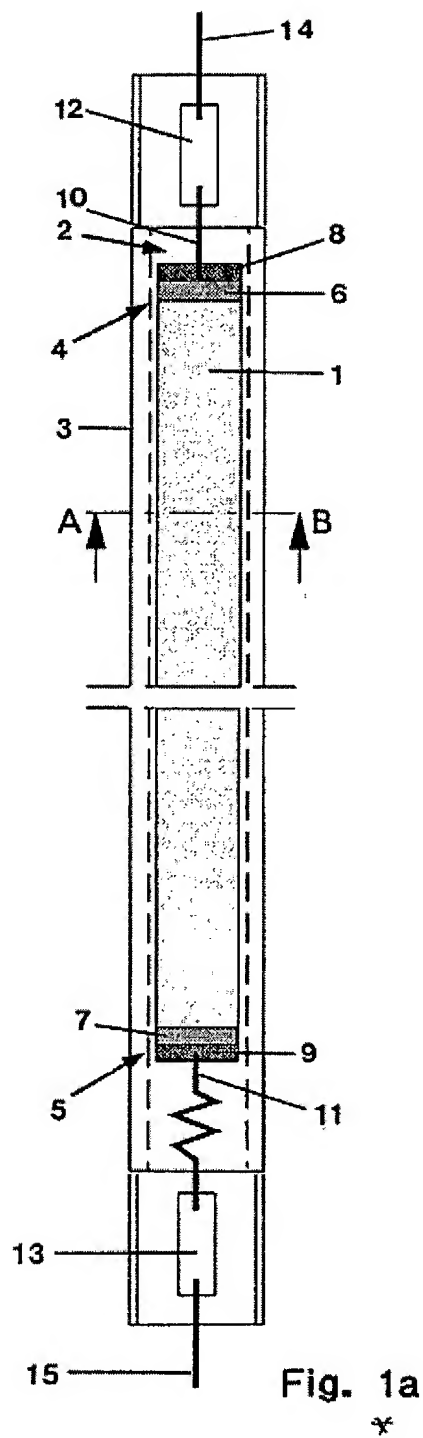
10. Infrared radiator, as claimed in one of the claims 6 thru 9, characterized in that there are provided at least two resistor cores [resistance bodies] (17, 18), which are oriented parallelly to one another.

11. Infrared radiator, as claimed in claims 1 thru 10, characterized in that inert gas, preferably argon, having a cold-

fill pressure of 600 to 900 mbar, is provided as filler gas of the quartz-glass capillary tube.

12. Infrared radiator, as claimed in claims 1 thru 10, characterized in that the interior of the quartz-glass capillary tube is evacuated [drawn out].

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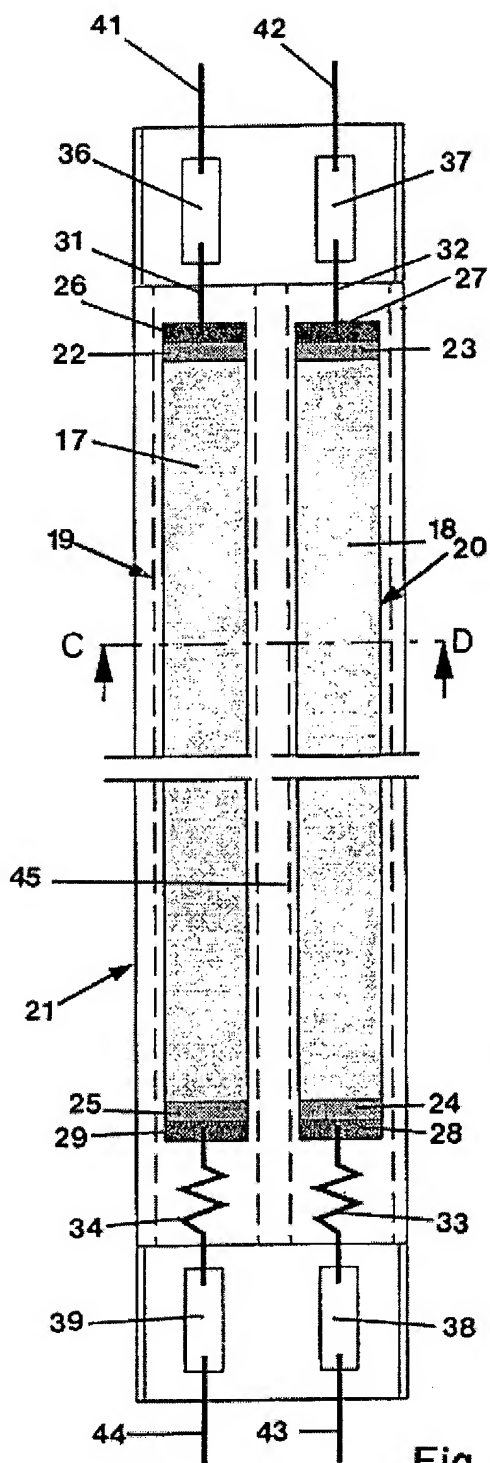


Fig. 2a

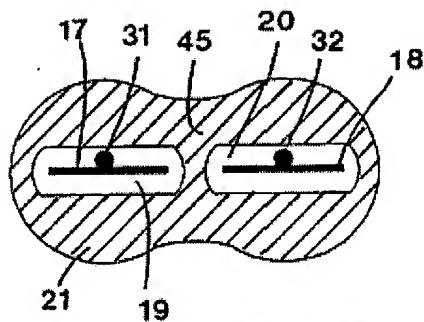


Fig. 2b

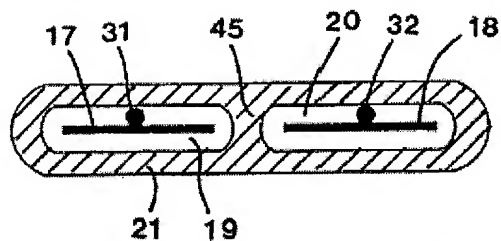


Fig. 2c